

OVERVIEW OF POLLUTION PREVENTION IN FOOD PROCESSING

This section presents an overview of P2 techniques that can be incorporated into your major process activities (e.g., storage, receiving and preparation, processing and filling, packaging, and storage and distribution), as well as your ancillary operations (e.g., refrigeration, cleaning, maintenance, and laboratory activities). The techniques shown in **Table 1** provide a general overview of several of the options available to you.

It is important to remember that not every P2 technique will work at every food processing facility. You should compare and evaluate these P2 techniques to identify those that may help you meet your P2 goals. You will then need to try a select few to determine what works in your facility, but does not compromise the quality and safety of your product. Consultation with the agencies regulating food safety is critical during the planning and evaluation of any pollution prevention technique(s) that you may adopt.

As shown in **Table 1**, there are many different kinds of P2 techniques. These techniques can be divided into categories, including process or equipment modification (primarily involving utilizing water conservation methods); operational and housekeeping changes; recycling/reuse; and material substitution and elimination.

Table 1 – Overview of Pollution Prevention Techniques

Type of P2 Technique	Technique	Process or Ancillary Activity	Ease of Implementation
Process/ equipment modification	Replacing traditional faucets	Receiving and preparation	Easy-Moderate
	Dry caustic peeling of fruits and vegetables	Receiving and preparation	Difficult
	Water shutoff during breaks	Processing and filling	Easy
	Water control units	Processing and filling	Moderate
	Installing flow meters	Processing and filling	Easy
	Exterior area water use reduction	Storage and distribution	Easy
Operational and housekeeping changes	Placing catch pans under potential overflows/leaks	Storage	Easy
	Covering outside storage areas	Storage	Easy
	Inspections and preventive maintenance of potential discharge areas	Storage	Easy
	Secondary containment	Storage	Easy-Moderate
	Monitor liquid fill machines	Processing and filling	Easy-Moderate
	Covering outside drains during loading and unloading	Storage and distribution	Easy
Operational changes cont'd.	Covering inside floor drains (in non-production areas only)	Maintenance	Easy

	Cleaning prevention	Cleaning	Easy-Difficult
	Precleaning and dry cleanup	Cleaning	Moderate
	Skim grease traps regularly	Cleaning	Easy
	Screening	Cleaning	Moderate
	Minimizing pests	Cleaning	Easy-Moderate
Recycling/reuse	Countercurrent washes	Processing and filling	Moderate
	Process water reuse	Processing and filling	Easy-Moderate
	Water recirculation units	Processing and filling	Moderate
	Water used to chill products	Processing and filling	Moderate
	Residuals management	Processing and filling, storage and distribution	Easy-Moderate
	Recycling refrigerants	Refrigeration	Moderate
	Reducing/recycling/reusing packaging	Processing and filling	Easy-Moderate
Material substitution and elimination	Laboratory inventory reduction	Laboratory	Easy
	General inventory control	Purchasing	Easy
	Using alternative refrigerants	Refrigeration	Moderate

While some P2 techniques are easy; others are more challenging. However, they all involve changes in how you do business. When you understand how much it costs to comply with all the regulations that apply to your facility, you will see that changing your operations makes good business sense.

TECHNIQUES FOR PROCESS/EQUIPMENT MODIFICATION

This section describes P2 opportunities that could be implemented at your facility. Information on whether the technique is easy or more difficult to use is included next to each listing, followed by a description of the technique. The ease of implementation can be determined by many factors, such as cost, adding new equipment, substituting materials, and if necessary, making associated process changes. Food processors should evaluate these P2 techniques before use to assure they do not compromise the safety of their product.

Replacing Traditional Faucets Easy - Moderate

As a food processing facility, you have probably found that traditional faucets can be one of the highest water users in your facility. Traditional faucets are often large water users because they have a high flow rate, and they can be left on while unattended, sometimes for hours at a time. By replacing the faucets with modified flow faucets, flow rates can be reduced by over 80%. By retrofitting faucets with on-demand foot or knee control devices or automatic shutoff nozzles, flow can be reduced even further. An example of such savings is presented below.

Case Study

At a Kentucky Poultry plant, 44 faucets were replaced and upgraded leading to an annual savings of \$37,174. The plant's cost of installing 44 restricted flow faucets was \$1,100 at \$25 per faucet. The new faucets had flow rates of 0.5 gpm compared to 1.5 - 3.5 gpm for the old faucets. The change reduced the process line's flow rate by 83.5 gpm (from 87.5 gpm to 4 gpm). Total savings were calculated as follows:

$$\begin{aligned} &83.5 \text{ gpm} \times 60 \text{ min/hr} \times 16 \text{ hr/day (work day)} \times 265 \text{ days/yr (operating days)} = \\ &21,424,400 \text{ gal/yr} \times \$1.75/1,000 \text{ gal} = \$37,174/\text{yr savings} \\ &\$37,174/\text{yr} / 365 \text{ days/yr} = \$101.85/\text{day} \\ &\$1,100(\text{total cost}) / \$101.85/\text{day} = 11 \text{ day payback period.} \end{aligned}$$

Note: An additional step for water conservation can be the use of automatic shutoff valves which can stop sprays when conveyor belts stop.

Dry Caustic Peeling of Fruits and Vegetables - Difficult

As a food processing facility, you may have problems with high levels of product residue in the water generated during the steam peeling process. In conventional steam peeling operations, potato peels may contribute up to 80 percent of the total plant wastewater biochemical oxygen demand (BOD). However, peeling processes can be modified so that the peel waste can be removed without using excessive amounts of water. One option is the "dry" caustic peeling process.

In a dry caustic system, peels are softened by caustic, and then a machine uses very thin soft rubber discs to remove the peels. These rubber disks are placed on rotating cylindrical rolls arranged in a circular revolving cage containing a feed screen through the center. The feed rate is controlled by the central screw conveyor. A final rinse to remove the last traces of peel and caustic is the only fresh water used.

Water Shutoff During Breaks - Easy

If your food processing facility does not have on demand faucets and hoses, water shut off during breaks can save thousands of dollars each year, without any capital investment. For example, shutting off water during breaks at the Kentucky poultry plant discussed earlier saved \$23,964 per year.

Water Control Units - Moderate

Your food processing facility may provide a continuous flow of fresh water for the raw product prior to and during preparation, or you may require continuous replenishment of a wash bath for each new batch of product. A water control unit can be added to the automatic process to reduce fresh water use. Wall-mounted control units, which control the flow and temperature of the water to the wash bath, can be installed. A water control unit costs approximately \$1,200. The benefits of this technique are in the cost savings which can be realized from decreased fresh water use and reduced wastewater discharge.

Installing flow meters - Easy

When combined with education and training, flow meters can help all employees become involved in your facility's water reduction program. Food processing facilities have found that flow meters allow them to measure and monitor water use on a constant basis. This technique is especially useful in cooking operations, where any excess water that enters the process is excess water that is heated. Thus by preventing excess water from entering the process, you can save energy costs of heating excess water. Flow meters allow all employees to monitor water use and help reduce water usage on a facility-wide basis.

Exterior Area Water Use Reduction - Easy

In addition to the pollution prevention techniques directly related to your production process, you have additional opportunities to reduce water usage. By educating all employees about the costs of water use and the benefits of reduction, your facilities can maximize cost savings. Some options for reducing non process-related water use include:

- Wash vehicles used outside the facility less often (Vehicles used inside the facility must be washed after use for safety.)
- Recycle wastewater from vehicle washing. (Your facility may want to evaluate technologies to recycle this wastewater.)
- Design and maintain landscapes requiring less water.
- Reduce irrigation water use by:
 - Installing timers on sprinkler systems
 - Watering in the early morning or evening when evaporation is lowest
 - Making sure irrigation equipment applies water uniformly
 - Installing drip irrigation systems
 - Using rain sensors.

TECHNIQUES FOR OPERATIONAL AND HOUSEKEEPING CHANGES

The following section describes P2 techniques that pertain to minimizing or eliminating wastes during waste segregation, separation, and preparation processes.

Placing Catch Pans Under Potential Overflows/Leaks - Easy

Placing catch pans or other mini-containment devices near hydraulic lifts, liquid drum storage or dry product storage areas at your food processing facility is an excellent technique to:

- Prevent waste from entering drains.
- Reduce the use of cleanup materials.
- Reduce wet washing.

While product that hits the ground is generally disposed of as waste or washed down drains, spilled product caught by catch pans can be recycled as animal feed. Catch pans located in a food

production area must be cleared regularly and should be removed from the production area for cleaning.

Cover Outside Storage Areas - Easy

Covering outside storage areas such as waste containers, product storage bins, or cleaning chemical containers is a relatively easy pollution prevention technique that you can implement at your facility. This technique can reduce contaminants in storm water discharges, and help you comply with the Best Management Practice requirements in your facility's storm water permit. Simple methods of coverage include:

- Moving chemicals inside the plant.
- Covering containers with a waterproof tarp when not in use.
- Replacing old dumpster covers with new watertight covers.
- Replacing or repairing leaking dumpsters.

A pollution prevention technique of moderate expense is to construct an aluminum panel roof under which waste containers, product storage bins, or chemical containers can be stored.

Inspections and Preventive Maintenance of Potential Discharge Areas - Easy

You may find that routine inspections uncover potential problems before they lead to water discharges. Preventive maintenance of outdoor processes can prevent discharges, thus reducing the need for cleanup water and subsequently reducing discharges to storm sewers.

Secondary Containment Easy - Moderate

Both outdoor and indoor storage facilities should be equipped with secondary containment, which is any device or structure that prevents a spill or leak from reaching the environment. One of the most effective secondary containment methods that can be used in an outdoor storage area is a concrete or asphalt pad surrounded by a berm or curb.

The pad and berm prevent any spilled or leaked material from coming in contact with the soil. If a berm is not available, sandbags, or absorbent socks around the perimeter of the area will provide some containment for a short period of time after a spill. Within buildings, depending on construction of the building, the walls and floor provide secondary containment for preventing spills or releases. One of the least expensive secondary containment devices consists of a metal tray covered by a metal grate, which can be used for 55-gallon drums and smaller containers.

The container sits on top of the metal grate so that any material or waste that released from the container simply falls through the grate and is collected by the metal tray underneath. The tray must be large enough to hold the entire volume of the container and should be protected from rainfall.

Monitor Liquid Fill Machines Easy - Moderate

Ensure liquid fill machines operate correctly and do not overfill cans, jars, etc. Overfill will end up on the floor and be washed down the drain, thereby increasing BOD levels in wastewater.

Ways to eliminate overfills include changing the speed at which the machine is operated, adding sensors, and ensuring that the containers flow smoothly through the machine (eliminating jarring movements which could cause spillage).

Cover Outside Drains During Loading and Unloading - Easy

Covering outside drains during loading processes at your food processing facility can prevent spills from reaching storm or process water drains with minimal costs. Preventing spills from entering the wastewater system has several benefits including:

- Preventing potential unauthorized discharges to storm drains.
- Preventing high pollutant concentration discharges to treatment plants.
- Allowing for a dry precleaning prior to washing a spill area.

Covering Inside Floor Drains (In Non-production Areas Only) - Easy

As with outside drains, covering floor drains can prevent spills from adding pollutants to wastewater. This should be done only in areas where food is not handled. Covering drains prevents spills and leaks from flowing directly to the wastewater system. This method provides additional benefits for your facility such as:

- Encouraging dry cleanup by making it more difficult to wash spills down the drains.
- Reducing/eliminating non-emergency use and replacement costs of spill equipment (e.g., booms, drying materials) used to prevent spills from reaching floor drains.

Cleaning Prevention Easy - Difficult

The best way to reduce water use for cleaning spills is to avoid the need for cleaning. Preventing spills from reaching the floor reduces or eliminates water in cleanup. Conducting regular inspections of storage areas and potential spill sites (machines, ovens, conveyors) can prevent spills from occurring, and thus from reaching the wastewater system. Dedicating mixing lines to specific products can reduce changeover cleanups. However, implementation of these lines may be difficult and expensive.

Precleaning and Dry Cleanup - Moderate

For equipment or machinery cleaning, cleaning techniques that reduce water use can save money on water and sewer charges. Techniques such as using squeegees or other dry cleaning equipment prior to wash down, followed by initial rinses with recycled water, have the benefit of allowing you to reduce the time and volume of water in final cleaning. The most important phase of precleaning, however, is dry cleanup.

Dry cleaning is a relatively simple process that involves removing a spill or spent product before washing a surface or container. Many food processing facilities have found dry cleanup to be an easy low cost alternative to hosing spills or unusable product down the drain. They have found that dry cleanup can significantly reduce BOD loading in wastewater discharges, reduce onsite

treatment, and reduce the frequency of screen cleaning. When done thoroughly, dry cleanup can prevent all but waste residuals from reaching your facility's wastewater system. To most effectively conduct dry cleanup, it is important to consider the following:

- All dry wastes should be protected and kept dry to prevent water from contacting the waste, or from entering the drains directly.
- Employees should remove food waste and debris from the production areas and associated equipment with dry methods before using water.
- Solids should be collected from the floor and machines by sweeping and vacuuming into a sanitary container which is kept out of the production area when not in use.
- A stiff broom which is kept sanitized and is cleaned regularly should be used to sweep materials off the floor; scraping and then brushing may be the only effective way to recover some materials from under equipment.
- To allow reuse, clean and store dry cleanup tools and utensils separate from regular wet cleanup gear and in a manner that will not jeopardize the safety of your product.
- Water hoses should be used only as a final alternative to a cleaning task. Any materials on the floor should be removed prior to hose down or wash down.

Dry cleaning can also be used as part of regular washdowns. When emptying cooking ovens or tanks, wastewater pollutants can be reduced by:

- Emptying waste products into barrels instead of pumping down the drain.
- Emptying machines by hand rather than hoses.

Skim Grease Traps Regularly - Easy

Skimming grease traps regularly reduces the amount of contaminants entering wastewater. Many facilities hire outside contractors to remove contaminants from grease traps on a periodic basis. For most effective use, however, more frequent skimming as part of regular housekeeping not only ensures that discharged wastewater has reduced contaminants, but also improves your ability to recycle and reuse process waters before discharge.

Screening - Moderate

Placing screens in all drains is an easy pollution prevention technique to collect and prevent solids from entering the wastewater stream. Screening can reduce BOD and solids levels in wastewater, reducing loads on your treatment plant. However, screening should be done only with food safety in mind. Screens need to be cleaned regularly to prevent residue buildup and must be removed from the production area to be cleaned. Cleaning must be done in a sanitary fashion.

Minimizing Pests Easy - Moderate

When you generate waste, your operating costs increase since you must pay for items, such as hazardous waste disposal which includes waste pesticide, herbicide, and insecticide disposal. By reducing these wastestreams, you can cut the cost of operating your facility. In order to maintain

compliance with waste pesticide disposal regulations, you and your staff must conduct a great number of environmental management activities. Instead, your facility can reduce the amount of pesticides, herbicides, and insecticides used at your facility “by design.”

Pest prevention by design is the engineering science which will help reduce the need for chemical control of rodents, insects, birds and other vermin. This involves landscape design, building design or remodeling and equipment layout and design. For example, short grass, neatly trimmed shrubs, paved access ways and proper drainage reduce or eliminate shelter areas for pests. Rodents are further discouraged by surrounding the building foundation with an 18 to 24 inch strip of 1/8 inch pebbled rock in a trench approximately 4 inches deep. This makes an excellent area for traps and bait stations.

Other pest control P2 techniques include:

- Eliminating improperly stored equipment, litter, waste, refuse, and uncut weeds or grass within the immediate vicinity of plant buildings or structures to reduce pest harborages.
- Properly sloping, and adequately draining the grounds to avoid contamination of food products through seepage or foot-borne filth. Poor drainage provides a breeding place for insects and microorganisms.
- Positioning outside lighting and focusing it away from buildings to attract night flying insects away from doors and windows.
- Reducing potential bird harborages by screening off harborage areas.
- Eliminating food that may accumulate near malfunctioning exhaust systems.
- Considering various types of rodent, insect, and bird traps. Trapped protected birds must be released.
- Maintaining adequate housekeeping programs.

TECHNIQUES FOR RECYCLING/REUSE

While reducing the input materials to your food processing operations is the most effective means of pollution prevention, recycling/reusing materials in your operations can be an equally effective way of reducing your solid wastestream. Try using returnable materials containers (except for food contact materials) and returnable plastic or wood pallets. Check with your suppliers for other suggestions on how you can recycle/reuse materials that end up in your trash bin. Examples of pollution prevention that involve reduction in waste cleanup that also could be considered methods of recycling are summarized below.

Countercurrent Washes - Moderate

Commonly used in food processing, countercurrent washing can replace parallel tank systems. Countercurrent systems are multistage (tank) systems in which water gets reused in preceding steps. In a three-stage countercurrent wash system, water from the third (final) stage is reused as make-up water for the second stage. Clean water is then used to replenish the final stage. Water

from the second stage is reused as make-up water for the first stage. Water from the first stage, which is the dirtiest, is commonly discarded.

The countercurrent washing system requires more space and equipment. The benefits of this technique are that it reduces the volume of fresh water used and reduces the volume of wastewater generated. Compared to a non-countercurrent rinse system, this method can reduce water usage by over 50%.

Process Water Reuse Easy - Moderate

Your food processing facility can reuse process water in several applications without compromising food safety. Be sure you comply with all FDA and USDA regulations regarding water reuse. Generally process water that has not been filtered or treated can be used as a first rinse in wash cycles, or for primary cleaning of floors and gutters. Examples of potential sources of water to be reused include final rinses from tank cleaning; refrigeration defrost; cooler effluent, and sterilizer effluent. Potential opportunities for water reuse include as boiler makeup and caustic dilution.

Water Recirculation Units - Moderate

Water recirculation units can be installed to reuse food processing wash water. The benefits of this technology are that it reduces fresh water use, wastewater discharge, and energy consumption. "Off-the-shelf" units (1) reduce fresh water use because wash bath water is reclaimed and reused and (2) reduce energy use associated with heating the washwater baths. Reclaimed water is already warm so less energy is required to heat it to the required temperature. Filters from the water recirculation units require disposal and are generally considered nonhazardous solid wastes. Food companies which contemplate installing water recirculation units should consult and comply with all appropriate FDA/USDA regulations concerning such a practice.

The costs associated with installing water recirculation units vary between food processing facilities. Capital expenditures are required for:

- The water recirculation unit (a minimum of \$500);
- Replumbing of the washwater bath system; and
- Ongoing operation and maintenance.

Water Used to Chill Products - Moderate

When recycling and recirculating water used to chill products, it is important that the water meets FDA and/or USDA standards. The FDA specifies that any water that contacts foods or food-contact surfaces shall be safe and of adequate sanitary quality. This standard applies to non-meat and non-poultry processing operations and allows for water to be recycled. (Water is recycled through a product cooler, which contains either a refrigerated chiller or a cooling tower to continuously cool the water between cycles.) For these operations, cooling water can be used for initial product washing; however, final washing must be conducted with potable water. USDA is responsible for meat and poultry processing operations, and has identified three acceptable processes for prechiller water recycling:

- Ozonation in a countercurrent flow contact column
- Screening, ozonation, sand filtration, and ozonation
- Screening, diatomaceous earth (DE) filtration and ozonation.

You will find that any of these processes can significantly improve water quality, reducing solids from between 28% (ozonation alone) and 65% (screen and filtration processes), and COD between 38% and 87%. In addition, these processes have reduced microbial loads by more than 99.9%.

An example of the significant savings you can achieve by recirculating chiller water is provided by the North Carolina Agricultural Extension Service. If a food processing facility uses 120,000 gallons of water daily to chill its products, it could save 96,000 gallons daily by reconditioning 80% of its waste chiller water. At \$1.90 per thousand gallons for water and sewer charges, this plant could save more than 24,000,000 gallons of water valued at more than \$45,000 per year. In addition, COD and TSS loads in the effluents could also be reduced by approximately 200,000 lb/yr (assuming an initial average of 1,000 mg/L of COD and TSS, respectively, in the untreated chiller water). If the surcharge on excess COD is \$0.20/lb, the surcharge savings could be almost \$40,000 per year. Thus the potential savings for water, sewer, and surcharges could total as much as \$85,000 per year. Other savings might be realized though by-product recovery and reductions in energy costs.

Residuals Management Easy - Moderate

Residues are defined as solid by-products that have some positive value or represent no cost for disposal. Food processing residues typically have nutrient/organic matter content that makes them economically recyclable. Some of the more recent technologies for reclaiming by-products for utilization include (1) recovering by-products for use in human food; (2) recovering by-products for animal feeds; (3) use as fertilizers for crop production; and (4) recovery for energy generation.

Recycling Refrigerants - Moderate

If refrigerants are recycled or reclaimed, they are not considered hazardous under federal law. As a food processing facility, recycling or reclaiming your refrigerants will reduce your hazardous waste disposal costs. If you have not done so already, it is important that you consider recycling your refrigerant or contracting a service to reclaim used refrigerant. To assist owners of commercial refrigeration, EPA has published a series of short fact sheets that outline regulations and pollution prevention techniques. For further information, call the Stratospheric Ozone Hotline at 1-800-296-1996.

Reducing/Recycling/Reusing Packaging - Easy

Many businesses across the U.S. generate extremely large amounts of nonhazardous solid waste daily. Much of the waste is from product packaging (e.g., plastic, cardboard, and aluminum). Incinerators and landfills, most often, are the final destination for most of this waste. There are, however, many avenues for diverting the solid waste from a solid waste disposal facility. Inefficiently managed solid waste can lead to excessive and unnecessary expenses for your facility. The following list provides several suggestions and resources to help you better handle your facility's solid waste.

- *Reduce Materials Used.* You can reduce or eliminate a number of input materials to reduce solid wastes generated by your facility. These materials include excess cardboard and plastic packaging.
- *Reuse Materials.* While reducing the input materials to your packaging process is the most effective means of pollution prevention, reusing materials in your operations can be an equally effective way of reducing your solid waste stream. Using returnable materials such as plastic crates or wooden pallets will reduce the amount of waste that ends up in the trash. Use of returnable materials for food contact should be avoided.
- *Recycle Scrap.* Many materials in the packaging process can be recycled, which will prevent them from ending up in the local landfill. They include paper, empty containers, cardboard, pallets, glass, and aluminum. Consult your vendors or local recycling companies for more ideas.

TECHNIQUES FOR MATERIAL SUBSTITUTION AND ELIMINATION

As a food processing facility, you should research materials that are safe for the environment (without compromising the safety and quality of your product) and cost less (e.g., by weight or usage amount) that you can use in food processing operations. If it is determined that a material

is not needed for a process, eliminate its usage to reduce extra costs in production. By educating all employees about the costs of waste disposal and the benefits of reduction, you can maximize cost savings by implementing pollution prevention techniques throughout your facility.

Laboratory Inventory Reduction - Easy

Keeping laboratory materials to a minimum can benefit your facility by reducing accumulation of unusable chemicals and preservatives. It can also provide incentives to minimize use where possible.

General Inventory Control - Easy

Ordering of Materials - Minimize wastes by ordering quantities of materials that match your needs. When ordering input materials, avoid overstocking by ordering according to usage demands. A good unit price is meaningless if the material goes bad on your shelf and you then have to dispose of it. Buy the largest container that allows you to use all of the contents before they go bad. This minimizes solid waste from packaging.

Inventory Control - Chemical containers labels list the shelf life for the material. You should follow these dates and keep inventories using first-in, first-out practices, which will help you reduce the amount of materials with expired shelf lives.

Using Alternative Refrigerants - Moderate

Your facility should consider using alternative refrigerants for your equipment. Many new alternative refrigerants are being marketed for use in stationary refrigeration equipment. You should ask your refrigerant supplier if an alternative is available and whether it is on EPA's Significant New Alternatives Policy (SNAP) program list. EPA's SNAP program determines what risks alternatives to refrigerants pose to human health and the environment. EPA evaluates the alternative refrigerant's ozone-depleting potential, global warming potential, flammability, and toxicity.

The SNAP evaluation, however, does not determine whether the alternative will provide adequate performance or will be compatible with the components of a refrigeration system. Food processors should consult with their refrigeration supplier/engineer prior to considering a SNAP refrigerant to ensure that safe temperature parameters for their product will not be compromised. To assist owners of commercial refrigeration, EPA has published a series of short fact sheets that outline regulations and pollution prevention techniques. For further information, call the Stratospheric Ozone Hotline at 1-800-296-1996.